

# Quality Enhancement of Low-Resolution Biomedical Images Using Multiwavelet Transform

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**Abstract**— The recent increase in the wide use of digital imaging technologies in consumer and other areas (e.g., security and military) has brought with it a simultaneous demand for higher-resolution images. The demand for such high-resolution (HR) images can be met by algorithmic advances in resolution enhancement technology intended with hardware development. Such HR images not only give the viewer a more pleasing picture but also offer additional details that are important for subsequent analysis in many applications. Therefore, a resolution enhancement (high resolution) approach using computational, mathematical, and statistical techniques has received a great deal of attention recently. One promising approach is to use Image-processing techniques to obtain an HR image (or sequence) from low-resolution (LR) image. The High resolution images are frequently required in biomedical applications, because the HR images provide the accurate spatial and intensity information for correct diagnosis. In this paper multi-wavelet transform and interpolation method are used for image resolution enhancement.

**Keywords**— Low Resolution image, Wavelet Transform Interpolation, Inverse Wavelet Transforms, High Resolution image.

## I. INTRODUCTION

Medical images typically suffer from one or more of the following imperfections such as Low resolution, High level of noise, Low contrast, Geometric deformations, Presence of imaging artefacts. These imperfections can be inherent to the imaging modality (e.g. X-rays offer low contrast for soft tissues, ultrasound produces very noisy images, and metallic implants will cause imaging artefacts in MRI). The biomedical applications require high resolution images for later image processing and analysis. The need for high quality image is one of the major challenges in image processing. So main aim of our project is to obtain High-resolution (HR) images from

Low resolution (LR) images. High-resolution (HR) technique enhances the image resolution and makes it clearer for human as well as machines in view for better information extraction which are not visibly cleared in Low resolution (LR) images. Following figure shows low resolution to high resolution image.



Fig.1: Low Resolution to High Resolution Image

Image processing plays a vital role in wide variety of application in the recent years. One of the important and emerging field in the area of medical imaging applications. Quality of the image in terms of its resolution is the major parameters for accurate diagnosis of the diseases. Hence image enhancement is the key area for the researchers, especially to improve the resolution and obtain a high resolution image from a low resolution observations. It means that pixel density within an image is high, and therefore an HR image can offer more details that may be critical in various applications. In almost every application, it is desirable to generate an image that has a very high resolution. Thus, a high resolution image could contribute to a better classification of regions in a multi-spectral image or to a more accurate localization of a tumor in a medical image or could facilitate a more pleasing view in high definition televisions (HDTV) or web-based images. The resolution of an image is dependent on the resolution of the image acquisition devices. However, as the resolution of the image generated by a device increases, so does the cost of the device and hence it may not be an affordable solution. Therefore we are emphasizing our work to avoid

hardware updating solution which is more costly and complex. So enhancement of images has become a major challenge in image processing area of research. In this project multi-wavelet transform and interpolation method are use for image resolution enhancement.

The wavelet transform has received considerable attention in the field of image processing due to its great design flexibility. The wavelet transform is most powerful and most widely used tool in field of image processing. Interpolation is a technique of enhancement which is used to estimate the continuous function values from discrete samples. This technique is used to find the missing values so as to obtain a clearer image.

## II. LITERATURE REVIEW

Yashar Kiarashi Nejad, Mohammadali Masnadi-Shirazit, Mehran Yazdi, Mohamadreza Zand Shahvar had implemented Quality Enhancement of Low-Resolution Face Images. Image processing of human face is one of the major problems in machine vision science. Since direct outputs of surveillance cameras usually have low resolution and they are not appropriate for face recognition, it is important to improve the resolution of images extracted from surveillance cameras. The main objective of this study is to refine the resolution of face images and to estimate high resolution image of human face in different poses which not even a low resolution image of that pose exists. For this purpose a method based on reconstruction or estimation of the desired image by using other human face images, stored in a database, is proposed. Techniques that convert Low-Resolution (LR) images to High- Resolution (HR) ones are known as Super-Resolution techniques

Yinpeng Jin, Elsa Angelini, and Andrew Laine had implemented Wavelets in Medical Image Processing and De-noising. Wavelet transforms and other multi-scale analysis functions have been used for compact signal and image representations in de-noising, compression and feature detection processing problems for about twenty years. Numerous research works have proven that space-frequency and space-scale expansions with this family of analysis functions provided a very efficient framework for signal or image data.

## III. PROPOSED WORK

The block diagram includes Input Image (Low resolution images), Pre-processing (Multi-Wavelet transformation), Feature extraction (Interpolation) , Post-processing (Inverse Wavelet transform /reconstruction) and Output image (High resolution images).

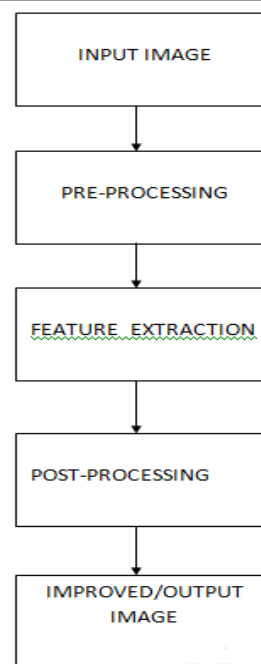


Fig.2: Block Diagram

### Input stage

Low resolution (LR) images is applied at the input stage which is to be process. In Low-Resolution (LR) images pixel density within an image is small, therefore offering less details.

### Pre-processing

The pre-processing stage includes Multi-Wavelet Transformations. The wavelet transform has received considerable attention in the field of image processing due to its great design flexibility. The wavelet transform has received considerable attention in the field of image processing due to its great design flexibility. The wavelet transform is most powerful and most widely used tool in field of image processing.

Fourier transform is a powerful tool use for signal analysis. A Fourier transform does not give information about the time at which frequency occurred in signal.

To overcome this problem, Short Term Fourier Transform was introduced. Even though a short term Fourier transform has ability to provide time information, but multiresolution is not possible with short term Fourier transform. Wavelet is answer to the multiresolution problem. A wavelet has important property of not having a fixed width sampling window. The Wavelet transform provides a time-frequency representation of signal. The wavelet transform uses a multi resolution technique by which different frequencies are analyzed with different resolution.

The wavelet transform broadly classified in to Continuous Wavelet Transform & Discrete Wavelet Transform. The

CWT is very time consuming. To overcome time complexity Discrete Wavelet Transform was introduced. The DWT is useful in image processing because it can simultaneously localize a signal in time and scale whereas DFT or DCT can localize a signal only in frequency domain. DWT can be implemented through sub-band coding.

Sub-band coding is a procedure in which input signal is subdivided into several frequency bands. Sub-band coding implemented through filter bank. A filter bank is collection of filters having either common input or common output. When the filter have a common input they form an analysis bank and when they share common output, they form a synthesis bank. In DWT, an image can be analyzed by passing it through an analysis filter bank followed by decimation operation. Following figure shows wavelet decomposition.

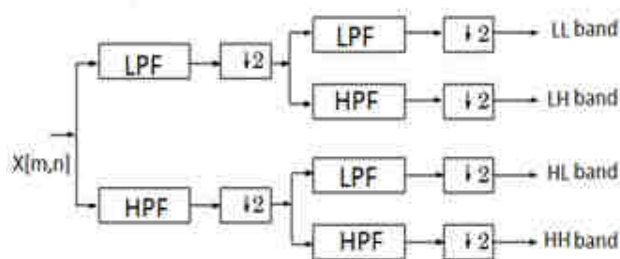


Fig.3: Wavelet Decomposition

In wavelet decomposition technique, The analysis filter bank consist of low pass and high pass filter at each decomposition stage. When the signal passes through these filters, it split in to two bands. The low pass filter, which corresponds to averaging operation ,extract coarse information of the signal. The high pass filter which corresponds to differencing operation, extract detail information of signal. The output of filtering operation is then decimated by two. A two dimensional transform is accomplished by performing two separate one dimensional transforms. First the image is along the row and decimated by two. It is then followed by filtering the sub-image along the column and decimated by two. This operation splits the image in to four bands, namely, LL,LH,HL and HH respectively.

### Feature Extraction

Feature Extraction stage includes interpolation of transformation components. Interpolation is a technique of enhancement which is used to estimate the continuous function values from discrete samples. This technique is used to find the missing values so as to obtain a clearer image. Interpolation defines many image processing applications such as image decompression, sub-pixel

image registration, image resolution enhancement, image fusion etc.

Interpolation is the process by which the number of pixels comprising an image is increased to allow printing enlargements that are of higher quality than photos that are not interpolated. Interpolation is commonly needed to make quality large prints from digital photos and film-scanned images. Interpolation is commonly needed to make quality large prints from digital photos and film-scanned images.

### Post-processing

The post-processing stage includes inverse wavelet transformation i.e. Reconstruction. After performing the inverse wavelet transform the reconstructed image is obtained. The performance of a reconstructed image is check by using some parameter like Peak Signal to Noise Ratio (PSNR), Structural Similarity Index Metric (SSIM) etc.

### Output stage

The high resolution (HR) images or improved images is obtain from low resolution(LR) images at the output stage. In high-Resolution (HR) images pixel density within an image is larger, therefore offering more details.

## IV. DATABASE FOR PROPOSE SYSTEM

Database is obtain from National Center for Biotechnology Information (NCBI). More than 2.5 million images and figures from medical and life sciences journals are now available through Images, a new resource for finding images in biomedical literature. The database was developed and will be maintained by the National Center for Biotechnology Information (NCBI), a division of the National Library of Medicine (NLM) at the National Institutes of Health. **National Institutes of Health (NIH):** NIH, the nation's medical research agency, includes 27 Institutes and Centers and is a component of the U.S. Department of Health and Human Services. NIH is the primary federal agency conducting and supporting basic, clinical, and translational medical research, and is investigating the causes, treatments, and cures for both common and rare diseases. Or I will visit to Hospital for low resolution biomedical images.

## V. CONCLUSION

This paper discusses about improvement in the resolution of Biomedical images. The major advantage of enhancement technique is use to improve the resolution of biomedical images which results in optimal treatment and recovery. Resolution enhancement is used to enlarge the input image in a way to make the output image looks sharper. Early, fast, and accurate detection of imaging biomarkers of the onset and progression of diseases is of great importance to the medical community since early

detection and intervention often results in optimal treatment and recovery. Enhancement technique is used to improve the resolution for digital X-ray mammography, CAT, MRI etc which results in optimal treatment and recovery.

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